1888MNRAS..48..334O

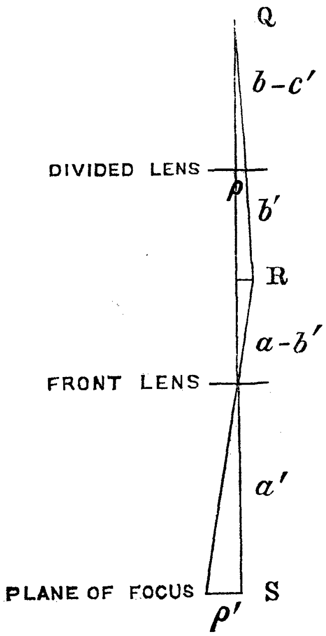
On the Condition that in a Double-Image Micrometer the value of a Revolution of the Micrometer Screw be independent of the Accommodation of the Eye. By Professor J. A. C. Oudemans.

Putting the focal lengths of the lenses of the micrometer (beginning from the object-glass), p, q, r, s; the intervals between the lenses (in the same order), a, b, c; then the proportions pointed out by Valz, adopted by Sir G. Airy, and by the constructors, Messrs. Troughton and Simms, are (*Monthly Notices*, vol. x. p. 161):

Focal length of front lens	$=p=$ arbitrary,*	
,, divided lens	$=q=-1$,	
,, field-glass	$=r=+1$,	
,, eye-glass	$=s=+1$,	
Interval between front and divided lens		$a=p$,
,, divided lens and field-glass		$b=1$,
,, field-glass and eye-glass		$c=3$.

Supposing the eye to be hypermetropic, so that it accommodates for rays converging to a point lying behind the eye-glass at a distance D, then, if we follow the rays of light from the eye to the focus of the micrometer, these rays, after passing each lens, will intersect the axis successively in four points, P, Q, R, S; if we put the distances of these points beyond the lastly passed lens, $=D'$, c', b', and a', these values all depend on D.

Let ρ be the distance between two successive turns of the micrometer screw, and ρ' the corresponding quantity in the measured object, we have



$$\frac{\rho'}{\rho}=\frac{a'}{a-b'}\left(1+\frac{b'}{b-c'}\right)$$

or, putting $b-c'=e$,

$$\frac{\rho'}{\rho}=\frac{a'}{a-b'}\left(1+\frac{b'}{e}\right);$$

but

$$b'=\frac{eq}{e-q},$$

thus

$$1+\frac{b'}{e}=\frac{e}{e-q}=\frac{1}{1-\frac{q}{e}},$$

$$a'=\frac{(a-b')p}{a-b'-p} \qquad \frac{a'}{a-b'}=\frac{p}{a-b'-p}$$

$$\frac{\rho'}{\rho}=\frac{p}{a-\frac{eq}{e-q}-p}\cdot\frac{1}{1-\frac{q}{e}}=\frac{p}{(a-p)\left(1-\frac{q}{e}\right)-q}.$$

* In the micrometer, constructed by Messrs. Troughton and Simms for the Leyden Observatory, in 1855, there are four front lenses, giving four magnifying powers, and having a focal length of 1, $\frac{3}{4}$, $\frac{1}{2}$, and $\frac{1}{3}$. The inch seems to have been taken as unity.

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From this expression it follows that, in order that $\frac{\rho'}{\rho}$ be independent of e, and consequently of D, we ought to have $a=p$, a condition already fulfilled in the micrometer, with the intention of obtaining an equal division of light upon the two segments of the divided lens.

Taking $D=\infty$, i.e. supposing the eye accommodated for parallel rays, we have, in the construction adopted by Sir George Airy,

$$\begin{aligned} D' &= s = 1, \\ c - D' &= 2, \\ c' &= 2, \\ e = b - c' &= -1, \\ \frac{q}{e} &= 1. \end{aligned}$$

Now in the denominator of the expression found for $\frac{\rho'}{\rho}$, the multiplier of $a-p$ is $1-\frac{q}{e}$, and, consequently, if the equation $\frac{q}{e}=1$ be really satisfied, this multiplier is $=0$.

Generally a will not be *exactly* $=p$, and q will not be *exactly* $=e$, but the product of the two factors, $a-p$ and $1-\frac{q}{e}$, will always be very small in comparison with q, so that we may safely conclude that: *in a double-image micrometer, constructed according to the proportions originally pointed out by Valz, the value of one revolution of the micrometer screw is practically independent of the accommodation of the observer's eye.*

In the papers, published by Sir George about this micrometer, I have not found that this point was attended to. Of course, if the images are not very distinct, it is always allowed to thrust in or draw out the eye-tube, containing the field and eye glasses together, but there might remain a doubt whether, if a normal eye has adjusted the micrometer to the focus of the telescope, a hypermetropic or a myope would be justified in changing the distance between the object-glass of the telescope and the whole micrometer. By the above consideration this question is answered in the affirmative.

Utrecht:
1888, *May* 9.

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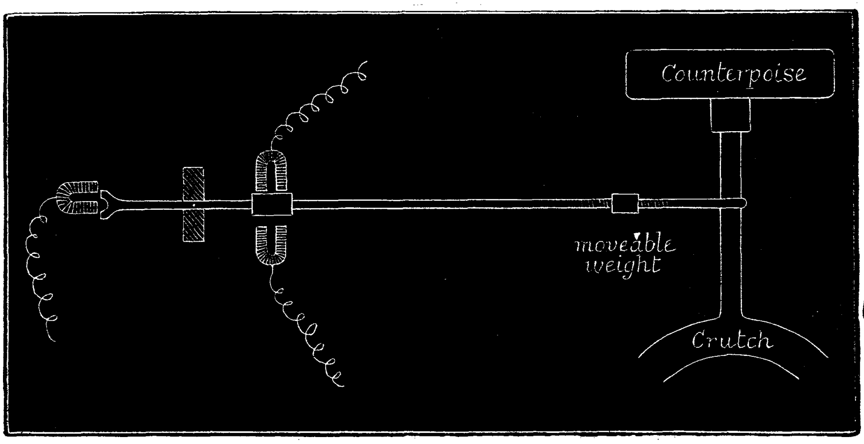
Note on a Simple Method of applying Electrical Control to the Driving Clock of an Equatorial. By A. C. Ranyard, M.A.

As considerable attention is at present being paid to the methods of controlling driving clocks of equatorial telescopes by the motion of a seconds pendulum, I think that a notice of a simple addition which I am having made to my driving clock may be of interest. I am getting rid of my old driving wheel, and propose to substitute a driving sector of 3-foot radius in its place. This gears into an endless screw driven, as in Sir Howard Grubb's clock, by an axis on which is an insulated wheel with rubbers nearly similar to the contrivance described by Lord Crawford and Dr. Gill in the *Monthly Notices* for



November 1873. Instead of the epicycloidal accelerating and retarding wheels used by Sir H. Grubb, I propose to make use of the instantaneous current to act upon magnets which move a small weight attached to the end of a lever backwards or forwards from one side to the other of the fulcrum of the crutch which rubs upon the governor disc. When the little weight attached to the lever is on one side of the fulcrum it decreases the pressure of the crutch, and accelerates the motion of the governor, and when drawn to the other side it increases the pressure and retards the motion of the clock. When the clock is going correctly a magnet draws the lever to the central position over the fulcrum. My governor is similar to that figured by Mr. Common in the *Memoirs*, in describing the mounting of his great 37-inch reflector.

If it is preferred, the height of the fulcrum with respect to the rubbing disc of the governor can be altered by moving a lever attached to an adjusting screw supporting the fulcrum. But the weighted lever above described gives an additional means of adjustment, as a small nut running on a screw, and acting as a counterpoise weight, may be moved upon the lever, or the position of the horseshoe magnets may be moved within certain limits, either towards or away from one another, or up to or away from the centre of motion of the lever.

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